FPL Energy
Seabrook Station

FPL Energy Seabrook Station
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March 17, 2008

Docket No. 50-443

SBK-L-08042

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Seabrook Station
Licensee Event Report (LER) 2008-001-00
Plant Trip due to 345kV Bus Fault

Enclosed is Licensee Event Report (LER) 2008-001-00. This LER reports an event that occurred at Seabrook Station on January 19, 2008. This event is being reported pursuant to the requirements of 10 CFR 50.73(a)(2)(iv)(A).

Should you require further information regarding this matter, please contact Mr. James M. Peschel, Regulatory Programs Manager (603) 773-7194.

Very truly yours,

FPL ENERGY SEABROOK, LLC

Gene St. Pierre
Site Vice President

cc: S. J. Collins, NRC Region I Administrator
G. E. Miller, NRC Project Manager, Project Directorate I-2
W. J. Raymond, NRC Senior Resident Inspector

IE22
NRR

ENCLOSURE TO SBK-L-08042

NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB: NO. 3150-0104 EXPIRES: 06/30/2007

Estimated burden per response to comply with this mandatory collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Seabrook Station	05000 443	1 OF 5

4. TITLE
Plant Trip due to 345kV Bus Fault

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
										05000
01	19	2008	2008	- 001 -	00	03	17	2008	FACILITY NAME	DOCKET NUMBER 05000

9. OPERATING MODE
1

10. POWER LEVEL
100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§: *(Check all that apply)*

- ☐ 20.2201(b)
- ☐ 20.2201(d)
- ☐ 20.2203(a)(1)
- ☐ 20.2203(a)(2)(i)
- ☐ 20.2203(a)(2)(ii)
- ☐ 20.2203(a)(2)(iii)
- ☐ 20.2203(a)(2)(iv)
- ☐ 20.2203(a)(2)(v)
- ☐ 20.2203(a)(2)(vi)
- ☐ 20.2203(a)(3)(i)
- ☐ 20.2203(a)(3)(ii)
- ☐ 20.2203(a)(4)
- ☐ 50.36(c)(1)(i)(A)
- ☐ 50.36(c)(1)(ii)(A)
- ☐ 50.36(c)(2)
- ☐ 50.46(a)(3)(ii)
- ☐ 50.73(a)(2)(i)(A)
- ☐ 50.73(a)(2)(i)(B)
- ☐ 50.73(a)(2)(i)(C)
- ☐ 50.73(a)(2)(ii)(A)
- ☐ 50.73(a)(2)(ii)(B)
- ☐ 50.73(a)(2)(iii)
- ☒ 50.73(a)(2)(iv)(A)
- ☐ 50.73(a)(2)(v)(A)
- ☐ 50.73(a)(2)(v)(B)
- ☐ 50.73(a)(2)(v)(C)
- ☐ 50.73(a)(2)(v)(D)
- ☐ 50.73(a)(2)(vii)
- ☐ 50.73(a)(2)(viii)(A)
- ☐ 50.73(a)(2)(viii)(B)
- ☐ 50.73(a)(2)(ix)(A)
- ☐ 50.73(a)(2)(x)
- ☐ 73.71(a)(4)
- ☐ 73.71(a)(5)
- ☐ OTHER

Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

FACILITY NAME	TELEPHONE NUMBER (Include Area Code)
James M. Peschel, Regulatory Programs Manager	603-773-7194

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX
B	FK	DISC	G192	Y					

14. SUPPLEMENTAL REPORT EXPECTED

☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)* ☒ NO

15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

ABSTRACT *(Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)*

At 2302 on January 19, 2008 while operating in mode 1 at 100% power, Seabrook Station experienced a turbine trip and subsequent reactor trip due to a fault on 345kV bus 3. This bus is located between the generator step-up transformer and the switchyard circuit beakers. The fault initiated a 345 kV bus lockout, which in turn tripped the main turbine and the circuit breakers associated with the unit auxiliary transformers (UAT), which normally supply the plant's 4,160 volt and 13,800 volt buses. The loss of the UATs initiated an automatic transfer of the plant buses to the alternate 345kV power source via the reserve auxiliary transformers. The transient caused a loss of all four operating reactor coolant pumps (RCP) for approximately one hour. Due to the unavailability of presssurizer spray with all RCPs stopped, the pressurizer power-operated relief valve automatically opened as designed to control reactor coolant system pressure. The operators restored normal pressurizer spray following the restart of one RCP at 0009 on January 20, 2008.

The cause of the 345kV bus fault was a failure of the operating shaft in the manually-operated disconnect switch for 345kV bus 3. On January 22, the plant entered mode 5 to repair 345kV bus 3 and returned to service on January 31, 2008. No adverse safety consequences resulted from this event.

17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* (17)

I. Description of Event

At 2302 on January 19, 2008 while operating in mode 1 at 100% power, Seabrook Station experienced a turbine trip and subsequent reactor trip due to a fault on 345kV bus 3 [FK, IPBU]. This bus is located between the generator step-up transformer [EL, XMFR] and the switchyard circuit beakers [FK, 52]. The fault initiated a 345 kV bus lockout, which in turn tripped the main turbine and the circuit breakers associated with the unit auxiliary transformers (UAT) [EL, XMFR], which normally supply the plant's 4,160 volt and 13,800 volt buses. The loss of the UATs initiated an automatic transfer of the plant buses to the alternate 345kV power source via the reserve auxiliary transformers (RAT). The transient caused a loss of all four operating reactor coolant pumps (RCP) [AB, P] for approximately one hour. Due to the unavailability of presssurizer spray with all RCPs stopped, the pressurizer power-operated relief valve [AB, PSV] automatically opened as designed to control reactor coolant system pressure. The operators restored normal pressurizer spray following the restart of one RCP at 0009 on January 20. On January 22, the plant entered mode 5 to repair 345kV bus 3 and returned to service on January 31, 2008. Some components did not respond as expected during the plant trip as discussed below.

Emergency Feedwater Isolation on High Flow

The emergency feedwater (EFW) [BA] system design includes a feature that will automatically isolate flow to a steam generator (SG) [AB, SG] under conditions of high flow, which may be indicative of a rupture in the feedwater or main steam line. Following isolation of EFW to a SG, the logic prevents automatic closure of additional EFW isolation valves for a high flow condition (the two-train logic permits isolation of a maximum of two EFW valves). During the event, EFW flow automatically isolated to SG-A; and during reset of the high flow signal, the EFW supply to SG-D isolated on high flow. The operators confirmed the EFW lines were intact, reset the EFW high flow signals, and restored EFW flow the the SGs.

Electrical System Response

Following the trip, non-essential buses 1, 2, and 4, [EA, BU] and emergency buses 5 and 6 [EB, BU] automatically transferred to the RAT power source. The supply breaker from the UAT to non-essential bus 3 tripped as designed; however, bus 3 did not transfer to the RAT and was locked out.

All RCPs tripped during the electrical transient that initiated transfer of the power supply for the station buses from the UATs to the RATs. The operators confirmed establishment of natural circulation flow and started one RCP approximately one hour following the trip.

Trip of the Station Air Compressor

The station air compressor [LF, CMP], which is powered from emergency bus 5, tripped at the time of the plant trip. The back-up air compressors automatically started and maintained air header pressure.

II. Cause of Event

345 kV Bus Fault

The cause of the 345kV bus fault was a failure of the operating shaft in the manually-operated disconnect switch [FK, DISC] for 345kV bus 3. The shaft's dielectric function failed and the shaft was broken

into pieces by the arc fault current to ground. The ground fault actuated the protective relaying, which resulted in a plant trip.

Emergency Feedwater Isolation on High Flow

Both EFW pumps automatically started to provide feed flow to the SGs. EFW flow to SG-A was automatically isolated due to a high flow condition. After EFW flow automatically isolated to SG-A, flow increased to the remaining three SGs. Consequently, when the operators reset the high flow signal on the SG-A EFW line, a subsequent high flow isolation occurred on the EFW supply to SG-D. The cause of the high flow in the EFW system was a reduction in SG pressures following the trip.

Electrical System Response

The bus transfer feature automatically closes the RAT supply breakers to the station buses when the UAT supply breakers to the buses trip. The feature initiates a fast transfer for cases in which the bus and RAT power supply are in synchronism. Otherwise, a slow transfer occurs after the bus voltage decays to less than 25% of rated voltage. Both the fast and slow transfers have an overall time permissive of 1.2 seconds for the 4,160 volt buses and 1.5 seconds for the 13,800 volt buses. Once the time permissive has elapsed, the bus loads trip on undervoltage and the bus transfer is blocked.

In this event, the bus fault caused a loss of synchronism, which disabled the fast transfer, so the bus transfers occurred using the slow scheme. The most likely cause for the failure of non-essential bus 3 to transfer to the RAT power source is that the running loads prevented voltage from decaying to less than 25% of rated voltage within the 1.2 second limit. In addition, the setpoint for the low voltage relay associated with bus 3 is less than or equal to 17%, and the last inspection found the setting at 5%. The RCPs receive a trip signal 20 cycles following a bus undervoltage condition. Because the bus fast transfer was disabled in this event, the 20-cycle timer tripped the RCPs before the 13,800 volt buses completed the slow transfer.

Trip of the Station Air Compressor

The station air compressor trippped as a result of the voltage drop on emergency bus 5, the power supply for the compressor. As the compressor slowed down in response to the electrical transient, the oil pump, which is driven by the compressor, slowed down and caused a reduction in oil pressure. The low oil pressure tripped the compressor to prevent bearing damage.

III. Analysis of Event

Seabrook Station design includes three offsite lines and two independent offsite AC sources: (1) one offsite circuit through the UATs, and (2) one offsite circuit through the RATs. The switchyard consists of metal-enclosed, gas insulated components (circuit breakers, disconnect switches, buses, surge arresters, potential devices, etc.) connected by an integral bus system. Pressurized sulphur hexafluoride (SF6) is used as the insulating and arc-quenching medium. The disconnect switches are integrally mounted within the SF6 insulated bus enclosures. The disconnect switch interrupting mechanism consists of a tubular telescoping contact that extends from the blade section into the jaw section of the disconnect switch. This contact is moved by a rack and pinion mechanism driven by the exterior lever through an insulated operating shaft.

As a consequence of the failure of the operating shaft for the manual disconnect, the protective relaying, upon detecting the 345kV bus fault, actuated to isolate the fault. This relaying tripped the main turbine, which resulted in a reactor trip, and tripped the supply breakers to the UATs, initiating an automatic transfer of the plant buses to the RATs. The loss of power to the UATs rendered inoperable one of the two offsite AC sources required to be operable in Modes 1 through 4 by Technical Specification (TS) 3.8.1.1, AC Sources – Operating. The TS limiting condition for operation for offsite AC power sources was met on January 22, when the plant entered mode 5, where only one offsite AC source is required.

The EFW system actuated as a result of the plant trip, and all safety systems functioned as designed. Following the reactor trip, letdown automatically isolated on low pressurizer (PZR) level. The subsequent increase in PZR level caused reactor coolant system (RCS) pressure to increase. With all RCPs stopped, normal PZR spray was not available. As a result, the PZR power-operated relief valve (PORV)-A operated as designed to control RCS pressure. Approximately 22 minutes following the trip, RCS pressure reached 2350 psig, and PORV-A opened several times over approximately six minutes. Two PORVs are provided with a design opening setpoint of 2385 psig. However, because PORV-A uses a proportional and integral controller, the PORV opened as designed below the 2385 psig setpoint. PORV-B, which is controlled by bistables with a setpoint of 2385 psig, did not operate during this event. Normal PZR spray became available approximately one hour following the trip when the operators started one RCP.

Although isolation of the EFW headers on high flow was not an expected response, further evaluation concluded that the system would function as designed in response to a design basis accident. In this event, the circulating water pumps continued to operate and steam dump to the main condenser continued. However, in the event of a design basis loss of power, the circulating water pumps would be unavailable, rendering the main condenser unavailable for steam dumping. The SG depressurization resulting from dumping steam to the condenser would not occur. Nonetheless, for this event, if a malfunction required automatic isolation of EFW, the affected SG would have depressurized more quickly than the remaining three SGs and would have isolated based on redundant high flow isolation signals for the affected SG.

This event had no adverse impact on the plant or on the health and safety of the public or plant personnel. The event resulted in a loss of one of the redundant off-site AC sources to the on-site electrical distribution system. However, the plant entered Mode 5, where only one off-site AC source is required, approximately 58 hours following initiation of the event. This event is of regulatory significance because it met the immediate reporting criteria of 10 CFR 50.72(b)(2)(iv)(B) for actuation of the reactor trip system with the reactor critical and 10 CFR 50.72(b)(3)(iv)(A) for actuation of the EFW system. The NRC was notified of this event at 0255 on January 20, 2008 (EN# 43921).

IV. Corrective Action

The immediate corrective action for this event was to replace the failed operating shaft in the manual disconnect. Additional corrective actions are planned to replace the operating shafts on the critical disconnect switches and to implement periodic monitoring that will identify partial discharge internal to the epoxy operating shafts.

FACILITY NAME (1)	DOCKET (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Seabrook Station	0500-0443	2008	- 001	- 00	5 OF 5

17. NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* (17)

Similar Events

Seabrook Station has experienced no similar events in the past five years involving a plant trip resulting from a 345kV bus fault.

Manufacturer Data

The Seabrook Station switchyard components were provided by ITE Imperial Corporation, which subsequently became ASEA-Brown Boveri.